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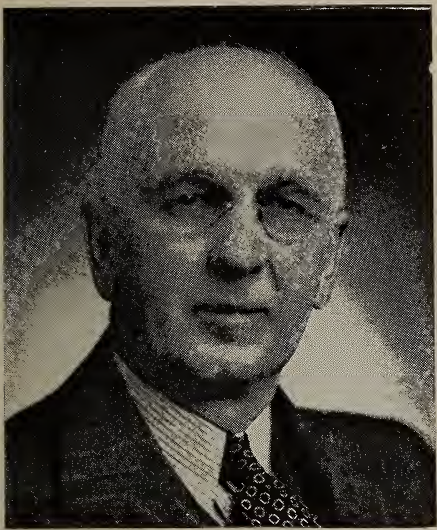


Foreword

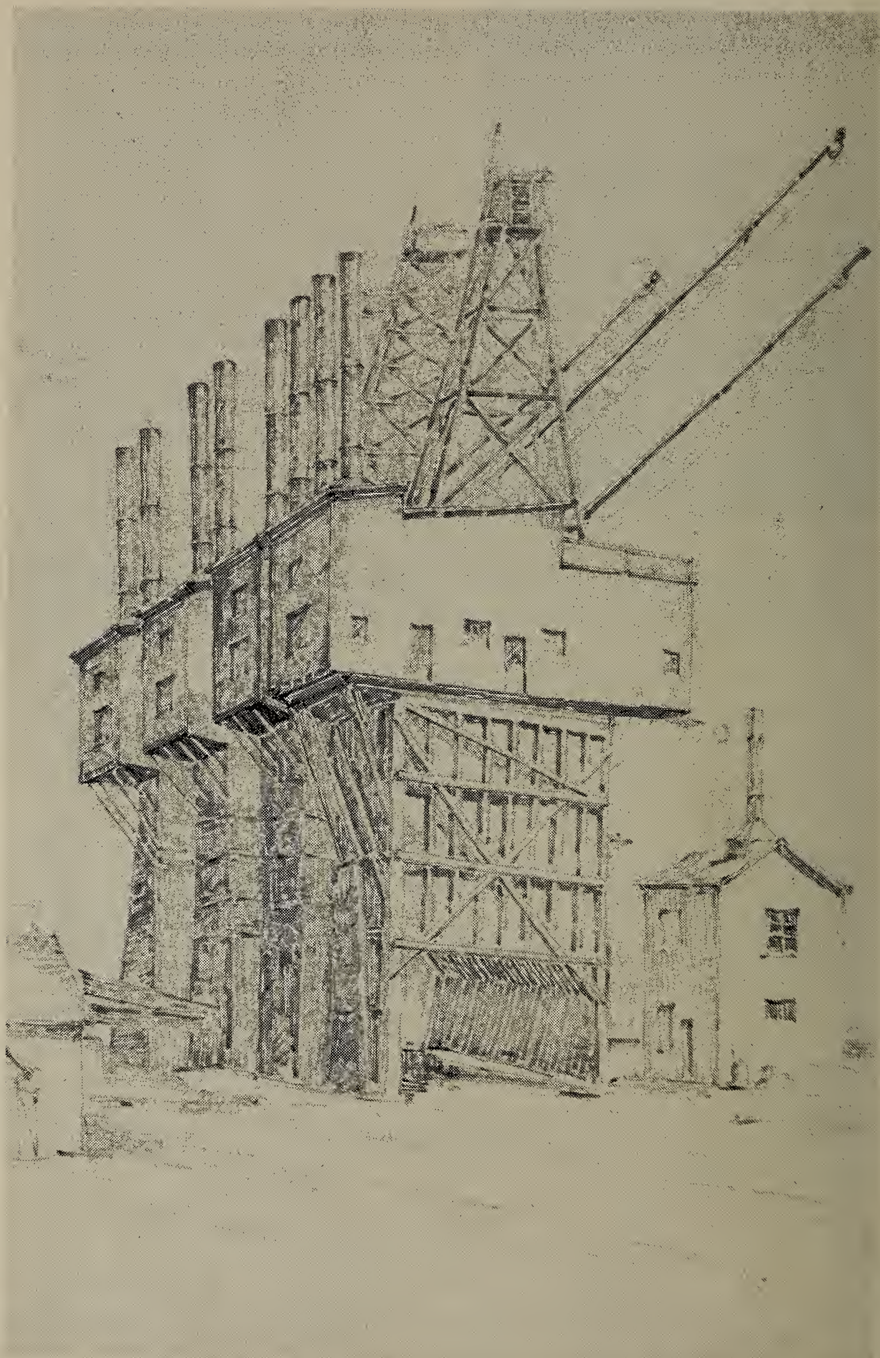
Dean C. R. Young
B.A.Sc.; D.A.Sc., C.E., D.Eng.

A Widening Field for the Engineer

AS the years go by it becomes increasingly apparent that the services of the engineer are being sought for more and more types of employment. A generation ago the young engineering graduate unquestionably accepted positions that held but one prospect—that of becoming a highly competent technologist, skilled in his trade and fully content to spend his full life at it.

Times have changed. As Canada slowly shifted from an economy based very largely on the opening up of her vast domains and the bringing to light of her natural resources, to an industrialized one, the engineer found himself with increasing frequency in productive industry. The tempo speeded up with the fall of France, in the late war, and throngs of young men took their places alongside those who had heretofore thought of themselves as the sole impelling force of industry. The technically-trained man was revealed as pre-eminently qualified to play a major role in the organizing and conduct of production. He had arrived industrially, and management was not slow to recognize his value. The magnificent part played by the scientist and technologist in theatres of operations emphatically confirmed what had been found out on the home front.

This country is rapidly developing research mindedness. That means jobs for engineers and scientists. A recent study made by a committee of the American Society for Engineering Education showed that the demand for engineers in research and development types of employment is increasing at a more rapid rate than that for men in design, production, management and sales. The numbers involved are smaller, but the ultimate result of these men embarking on tasks that create new industries and expand old ones will mean greatly increased opportunities for their colleagues in all the manifold aspects of engineering activity.



Dominion Coal Loading Docks, Montreal G.F.Y. Chan

Editorial

IT has been asserted by the proponents of behaviourist psychology that the greatest stimulus to mental activity is the spoken word. In fact some state that the superiority of man over the lower animals is chiefly due to the stimulus of speach. Certainly if this is true of the spoken word it is equally true of the written word. The greatest mind is wasted if it can not receive nor give stimulation to others. The greatest mind deprived of its sense faculties would remain sterile no matter how long it existed. The stimulus for thought must come from without.

A man who enters any field of intellectual endeavour is seriously and perhaps permanently handicapped if he lacks this ability to express his ideas to his fellows. He cannot formulate the broad plan since he lacks the ability to present these plans to his fellows. He must remain on a level that allows him to carry out the plans of other men.

If this is true of mental activity generally, it is particularily true of engineering. The skillful design, if not adequately described, will never be used. The keenest analysis of a problem is wasted if it is not presented in such a way as to cause men to act on and solve the problem. The leaders and guides are those men who are able to express themselves.

Self expression should be learned at University. The best possible way of doing this is to contribute to the publication of the faculty. By so doing writers have the advantage of seeing the effect of their work on their readers. This advantage can be provided in no other way. Clarity and style will improve with experience and with the ground work laid there will be further improvements.

This faculty is fortunate in having in Toike Oike a publication exclusively devoted to undergraduate literary contributions. This magazine should be published not annually but rather quarterly. The stimulus to mental activity would benefit not only the contributers but also the readers.

Definite progress will be made if in future years contributions warrant the publishing of this magazine two or even three times a year.

Ramjet

G. H. Tucker

IN the past few years the Ramjet has received considerable publicity and its possibilities have been dramatized, but there has been a marked lack of any specific data or information on this type of jet engine. In view of this the writer constructed a working model of an athodyd, (Aero-rhermo-dynamical-duct is the technical term for ramjet) using formulae given by a Mr. Z. Fonberg in one of his technical papers on the subject.

The Athodyd is a comparatively new type of reaction engine; it was invented by the French Engineer Lorin in 1913 and is capable of operating at higher altitudes and greater speeds than any other power plant (with the exception of rockets). It is now being developed by the A.A.F. at Wright Field as a possible answer to the limitations of present day engines.

The Ramjet has three possible fields of application.

1. In supersonic aircraft.

2. Because of its light weight and ease of fabrication, it may also be used for subsonic expendable missiles.

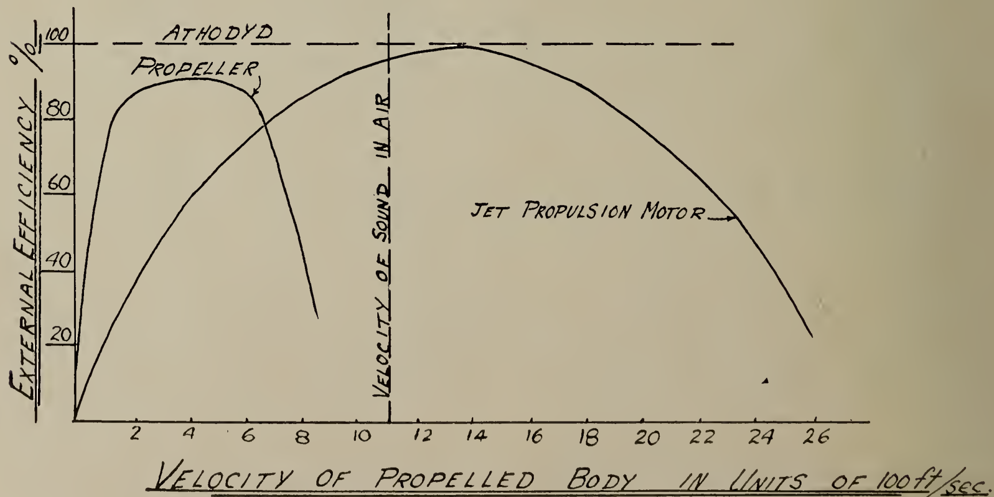
3. It may have possible application for rotary wing aircraft where rotor tip speeds approach the speeds desired for ram jet operation, and where economy of engine weight and freedom from power transmission problems compensate for lower fuel economy. (1 lb. of fuel gives 1 lb. of thrust for one hour).

The writer has conducted experiments with a view to obtaining information regarding the suitability of the athodyd for powering helicopters.

The athodyd consists of divergent duct (A) surrounded by a streamlined fuel jacket (B), and an injection burner (C).

The Cycle and Theory of Operation

Consider a small quantity of air entering the duct at a high velocity



equal to the forward speed of the athodyd. Owing to the divergence of the duct, the kinetic energy of the high velocity air is converted into pressure energy. (Ram pressures as high as 14 atmospheres have been developed). Into this high pressure air, gasoline vapour is sprayed by the fuel injector (C), the fuel in the jacket being vaporized by the heat from the athodyd itself. Thus the model has to be heated to start cperation. The vapor is ignited by a spark across the terminals (E). This causes an increase in pressure and a rapid expansion of the gases in an attempt to fulfill the basic conditions of equality of pressures ,(atmospheric) which exists between the front and rear of the athodyd. This rapid expansion causes an increase in the velocity of the gases, and provides the thrust. With perfect streamlining the forward speed of the athodyd is theoretically equal to the velocity of the discharge gases. Then, since the gases gained velocity in the duct, the athodyd is constantly accelerating.

Athodyd Starting

The athodyd as described above, obeys the general laws of reaction motors, and using the same formulae with slight modifications, the thrust, power and efficiency can be calculated.

Since the pressure on each side of the athodyd is atmospheric, then the thrust can be measured by the difference between the area of the in take and the exit of the duct, multiplied by the induced ram pressure.

Testing Apparatus

According to Mr. Fonberg, the thrust, power, and efficiency of this type of jet engine will increase up to the speed of sound in the surrounding air, when the critical flow pressure is reached. Then the theoretical output of this motor will remain the same for any increase in speed beyond this point. (The critical flow pressure is that pressure in the combustion chamber above which any pressure increase will give no corresponding increase of velocity to the discharge gases.)

The power of an athodyd increases as the cube of the velocity and hence the external efficiency is 100% as shown in comparison with that of the propeller and turbojet in the above graph.

The outstanding disadvantage of this type of engine is that for efficient operation it must be travelling at a velocity of at least 400 m.p.h. Even at this speed it develops only 12.5% of the total power developed at the speed of sound. At present this high initial velocity is

obtained by the use of auxilliary rockets or catapults.

Although high speed must be obtained for efficient operation of the athodyd, a model such as that just mentioned has started with little assistance and attained a speed of 60 m.ph. In this case the model was mounted at the end of an eight foot rotating arm and to obtain the initial velocity the arm was rotated under power until the athodyd was able to maintain itself.

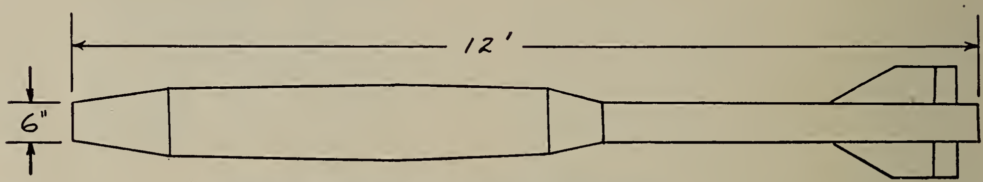
The photgraphs included are of the actual model.

The calculated performance of the model shown in the photograph is as follows:

Velocity M P.H.	Thrust Lbs.	Horsepower
170	.72	0.37
300	2.24	1.79
400	4.00	4.26
600	8.95	14.3
750	14.5	29.5

These figures should serve to illustrate the practical use these engines have in helicopters. e.g. An Athodyd of 4 inch diameter and length 13 inches at 550 M.P.H. (a reasonable rotor tip velocity) would develop 40 P.H. Using three rotor blades 120 H.P. would be developed, and this is sufficient to power a small helicopter.

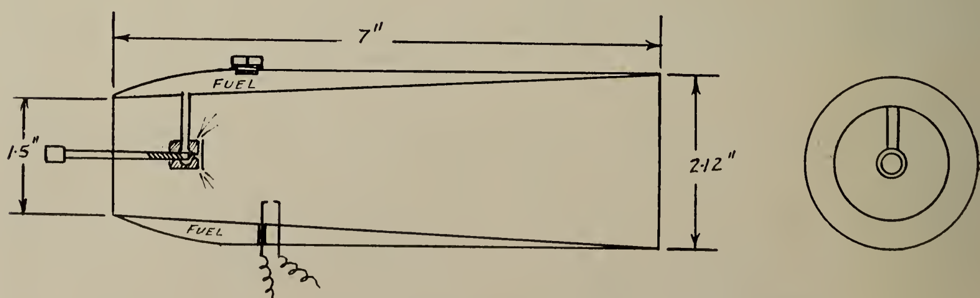
The model was built from information gathered in 1945, but the latest pictures of athodyds shows the trend toward an elongated combustion chamber and long discharge nozzle, as shown in the following diagram.



LATEST RAMJET DEVELOPMENT

The above ram jet has attained velocities ranging from 800 m.p.h. to 1500 m.p.h. developing around 3000 H.P. and weighing 75 lb.

From a recent photograph of a Mustang fighter aircraft with anthodyds mounted at the wing tip', it is evident that the practical use of these engines in ultra high speed aircraft represents the next stage in aircraft development.



DIMENSIONS OF MODEL ATHODYD

Skule For Art

Drew Douglas

"OH, ENGINEERS!" Barbara exclaimed with a disdainful motion of the hand, "all they know is science."

It was disturbing. My first weeks and months at "Skule" had confirmed the opinion that engineering was the only course of study. The work was fascinating. If some subjects were difficult, one felt that these were the tools of science which might some day be used for great purposes. Now I was emphatically told by a member of the opposite sex—a most winsome creature with long black hair and dark eyes—that engineers were missing something of real importance at college. It was indeed disturbing.

Other incidents were stimuli for a growing uneasiness of mind. In the art gallery at Hart House there was a fine collection of the work of art students. The section of this display which especially caught my attention was a group of preliminary exercises in lines. The printed cards describing these exercises said that some lines were drawn to express motion to the right or left, up or down, advancing or retreating. Some were intended to convey a mood of heaviness or gloom; others of mirth or gaiety. I looked in vain for any familiar shape, but saw only unfamiliar patchworks of lines—straight, curved, angular, wiggly. A few I understood, but most were beyond me. Perhaps "skulemen" were indeed afflicted with a peculiar kind of blindness.

Probably many students of the liberal arts felt about science as Barbara did. How did "skulemen" feel about the arts? I asked my class mate, Bill Jones.

"Art!" replied Bill scornfully, "it's impractical, unrealistic. The world never will get anywhere until people drop all that stuff and begin to use scientific methods."

Perhaps the majority of "skulemen" felt as Bill did; perhaps not. It seemed to me that many "skulemen" coupled a suspicion of all things artistic with an aggressive assertion of their beloved science applied to all subjects which they met.

The illuminating idea which brought these misunderstandings into focus was supplied by our mathematics professor one day when we were struggling with the mysteries of the integral. He said that when perfectly definite rules could be applied to some branch of knowlege it was a science, but when no definite rules applied, it was an art. He then pointed out that since integration could not always be carried out simply by following a definite method or set of rules, it was something of an art.

Surely the answer to my questions lies in this simple distinction between an art and a science. I felt better about the wiggly lines in the art gallery. One could never, never make use of them in engineering drawing, or find their equations as the loci of a point. The exact rules of algebra and geometry did not apply to them; their appreciation called for a more open, suggestible frame of mind.

Many problems cannot easily be approached by the methods of science; some form of art is needed. But scientific-minded people often try to apply the methods

of science to subjects which call more for an artistic approach. Frank, a radio enthusiast, was showing me the merits of his latest audio-frequency amplifier circuit. Through the loudspeaker came a colorful passage from Lohengrin.

"Hear that bass boost!" purred Frank with an eager gleam in his eye, and turning up the volume a little.

"Sounds great," I mumbled.

Then he hastened to plot a graph of decibel gain against audio-frequency, while Wagner's stirring chords fell unheeded. About audio-frequency amplifiers Frank knew almost everything—except how to enjoy them. We all know people who see only the technical details of their work. There is the inventor of some ingenious gadget, who makes a model of it so ugly that no woman would want to have it in her home. There is the amateur photographer, master of cameras and filters, whose work remains flat and uninteresting.

At this point I hear indignant objections from some of my readers (if I still have any readers).

"Of course, an appreciation of art makes life more enjoyable, but what of it?" they chorus. "What has this to do with engineering? How does it affect us?"

We "would-be" engineers should take an interest in art because at "Skule" and afterward we shall certainly meet problems which cannot be effectively tackled by purely scientific methods. The less tangible, creative approach of art will be helpful, even essential, and by taking some interest in art and the way artists work we can learn about this artistic approach. If your artistic talents are as meagre as those of the writer your interest in art may take an elementary form, but it will bring worthwhile results nevertheless.

I do not for one moment propose that we should be less objective in our thinking only that we should be alert to recognize those occasions when a subjective attack on a problem may be an advantage. After all, we have seen that even in mathematics, that most perfect science, there is a kind of art. If art has a place in mathematics surely there is room for it in the other sciences.

Oh Calculus

Oh Calculus, thou sly evasive knave,
I ought to be thy master, not thy slave!
'Tis thou who should be subject unto me,
Not I, a victim of thy mastery!

'Tis man who made thee what thou art to-day,
So play the part thou hast been meant to play.
You can't escape thy pre-planned destiny;
Thou creature of our ingenuity!

Conceal thy pride, thou vain filled Calculus!
And be a faithful servant unto us;
Be grateful for the life man gave to thee,
And please don't differentiate with me.

R. L. DELANEY

Artist, Woodsman and Guide

G. D. Garland

"WEST WIND" TOM THOMSON
Courtesy Toronto Art Gallery

"SEE you to-morrow, fellows."

With these words, the lone fisherman paddled out into Canoe Lake, leaving the little group on shore to their regular morning tasks. Soon the familiar grey canoe was lost behind a densely wooded island. Probably not one of those on shore at that moment realized the impending tragedy. For the man was Tom Thomson, who has since become recognized as Canada's finest artist, and the day, July 7th, 1917 was the day of his death.

Exactly forty years before, Tom was born in a small stone cottage near the village of Claremont, Ontario. When he was less than two months old, his family moved to the shores of Georgian Bay. It was here that Thomson became an expert fisherman and woodsman. Tom was always, in his own mind at least, a fisherman first and an artist second. Eventually he reached Toronto in his search for employment, and here he was hired as a commercial artist by a printing company. During the years that fol-

lowed, he received that training in composition and design which marks all his great paintings. Tom, however, grew daily more restless for the bush until in 1912 he packed his belongings and left for Algonquin Park.

During that summer of 1912, there grew in Thomson a deep love for Algonquin. It was then that he began his experiment in landscape sketching and painting. That fall Tom returned to pass another winter at the drawing board.

In the early spring of 1913, Thomson went once more to Algonquin Park this time for serious painting. As his camping place, he chose a beautiful point on Canoe Lake. That point became his virtual home for the last four years of his life. During those years he spent only a few months each winter in Toronto, painting the canvass the sketches of the summer. Few people to-day realize that such canvases as "The West Wind" and "Northern River" were painted in a one roomed shack overlooking Rosedale Ravine—the new site of the Canadian Tire Corporation.

By the spring of 1917, Thomson was accepted throughout Canada as one of the most promising of the younger painters. To the residents of Canoe Lake, guides and park rangers alike he had become a trusted friend, the equal of the best of them in fishing, guiding, and canoeing. Early in July, after a busy season of painting, Tom planned an overnight fishing trip. He set out alone from Mowat Lodge (where he had just purchased some provisions) on that rainy Sunday of July 7th, waving a carefree good-bye to his friends on the wharf. He was paddling his own grey canoe, whose peculiar shade was known throughout the Park.

Thomson did not return the next day, and when an overturned canoe was found floating in the lake concern for him spread among his friends. No one reported seeing him after he had paddled away from Mowat dock the previous day. Immediately a search party was organized by the Park Ranger, Mark Robinson—perhaps Tom's closest friend. For eight days the searchers pushed through the thick brush about the shores of Canoe Lake and paddled over the neighbouring lakes. No trace was found, until . . . . .

A little girl and her father, a Toronto doctor were fishing in Canoe Lake on July 18. Near the spot where Tom's Canoe had been found, the girl felt a pull on her copper troll.

"Daddy, I have a fish." she cried.

The father reeled in the line, surprised at the great weight on it, until he saw the body of a man coming out of the green depths. Immediately he stopped reeling and rowed to shore, where he made the line fast. Two guides from the Lodge were called, and the body was removed.

There was little doubt about identification—the man was Tom Thomson. His feet were bound in his own fishing line, and a bruise scarred his right temple. A coffin, undertaker, and coroner were sent for and arrangements were made for the burial. It happened that the coffin and undertaker arrived at Canoe Lake before the coroner, and it was decided to bury the body immediately, in an old cemetery overlooking Canoe Lake—a relic of the lumbering days of 1890. The next day after the body had been effectively removed from any post-mortem examination the coroner arrived to hold an inquest. On the basis of a brief report made by the doctor who reeled

in the body, a verdict of accidental drowning was reached and so it stands until this day.

No doubt many people at the time had cause to doubt the verdict, and in the thirty years since then, suspicion and speculation has grown throughout the North. Around many a blazing campfire, and in many a rough log house, theories to explain Tom's death have been formulated. Out of this maze of Canoe Lake folklore, we can pick some startling questions, which remain unanswered:

How did Thomson an expert canoeist come to upset, on a calm July day?

If he did upset, why should such a strong swimmer drown a few rods from shore?

How did Tom's legs become bound in his fishing line?

What caused the bruised cut across his temple?

Why did Thomson's body stay at the bottom of a shallow lake for eight days, and then come to the surface only when pulled up by a copper line?

Could Tom Thomspon have been murdered? Did someone paddle up to him, and cut off from all watching eyes, strike him with the blade of a paddle, then weight his senseless body and push it out of his canoe? Many people believe this was the case, but no one has ever been able to name the mysterious assailant, or find his motive. If there were such a person, he must have been a friend of Tom's to have approached close enough to strike, without arousing the artist's suspicion. No stranger was seen to paddle into or out of Canoe Lake on that Sunday in July. All of Thomson's acquaintance however, spent the morning in a group at Mowat Lodge. No the mystery of Tom Thomson's death was not an easy one to solve, in 1917, and today, after so may of the old-timers of Canoe Lake have died and facts have become inseparably mingled with fantasy, it must be considered beyond solution.

Thomson was buried overlooking Canoe Lake, but once again fate stepped in to add still more to the mystery of his death. The Thomson family in Owen Sound decided to have the body moved to that city. Accordingly two undertakers were sent to Canoe Lake with a new coffin, to find the body. According to legend, they arrived on a dark, stormy night, and went to the old lumber camp cemetery alone. They returned in a few hours to say they had removed the body, sealed it in the coffin, and were ready to leave in the morning. In Owen Sound, Tom's second funeral was held without incident but on Canoe Lake sinister stories were repeated. It was said that the undertakers had not opened the old grave at all, instead they had filled the new coffin with rocks, and sealed it. In order to complete their deception they loosened the soil on the top of the grave. Attempts to determine definitely the truth of this theory have been fruitless. The grave at Owen Sound has never been opened. Unnumbered searchers have dug about the old Canoe Lake site but the exact location of Thomson's grave has been lost, so their labours have not been repaid.

That, in brief, is the little known legend of Thomson's death and burial. Somewhere possibly still near Canoe Lake, there may be alive today a man who knows the exact story of Tom's death. Elsewhere, there may be men, who know for certain where his body lies. If so, they have kept their secrets well.

A New Development in Heating-

The Heat Pump

J. R. Connell

RECENTLY heating engineers have become more and more interested in the use of the heating machine or "heat pump" as a new method of domestic heating. Articles are appearing more and more frequently in engineering journals and the daily papers as the "reversed refrigeration cycle," as they like to call it, is put to work in the heating of office buildings and homes in different communities. It is operated by electricity and had a number of features which appeal to the general public. The first of these is that to heat any one house the heat pump will use roughly one quarter of the electricity which would be required if the house were heated by converting the electricity directly into heat in resistance heaters. Secondly, by a simple manipulation of valves the heat pump can be made to operate in the opposite direction and it will cool instead of heat, so that interchangeable heating or cooling may be had at will from one and the same device. The heat pump cycle, which will be explained later, is definitely not a reversed refrigeration cycle as newspaper articles would lead us to believe, nor is it related to the refrigeration cycle, for the simple reason that they are identically the same thing.

To understand its operation requires a knowledge of only a few simple thermodynamic facts, which are:

(1) All substances exist in any one of three states, that is, solid, liquid, or gas. For the purpose of reference the gaseous state is generally termed the highest state, the solid state is the lowest and the liquid state is the intermediate state. A substance may be readily converted into either of its other two states if the correct temperature conditions are applied.

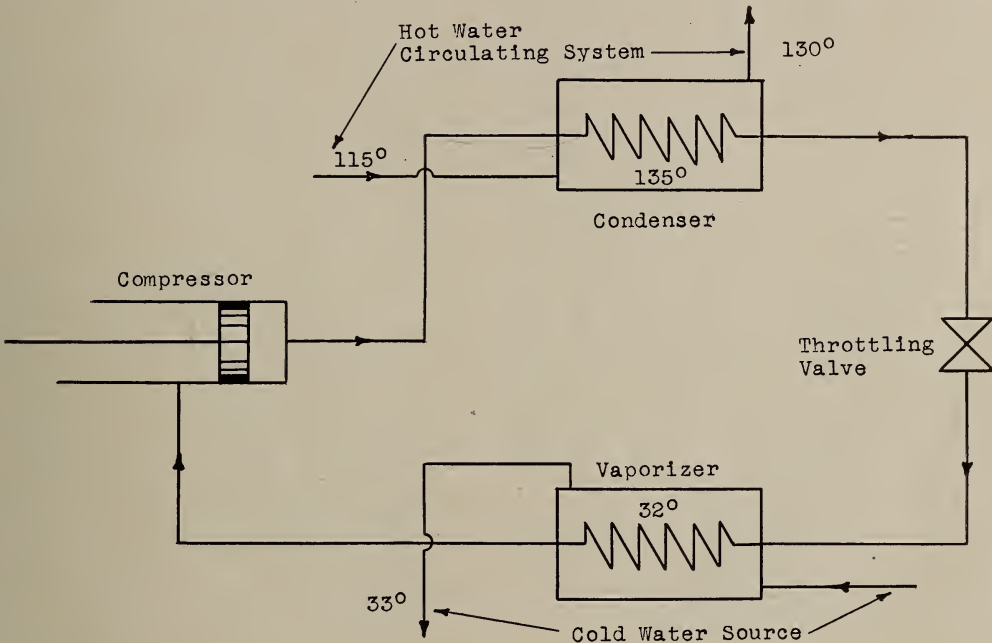
(2) To convert a substance into its next highest state requires the addition of a definite amount of heat, called the latent heat of the substance. If the substance is being converted from the solid to the liquid state, it is called the latent heat of fusion, and if the substance is changed from the liquid to the gaseous state, it is called the latent heat of vaporization. Similarly, if the substance is converted to its next lower state, the latent heat is given up to its surroundings.

(3) Increasing the pressure on a substance tends to change it into its next lower state. In many, but not all, cases, the substance can actually be converted to its next lower state by creating a high enough pressure upon it.

We know that anything whose temperature is not absolute zero contains some heat. All heat does not have the same value however, as heat is valued or "graded" in proportion to the temperature at which it exists. High-grade heat such as is found in steam is very useful and valuable because we can use it to operate engines and do work. With medium-grade heat such as in hot water we can cook our food, wash

our clothes and heat our homes, so that it too is useful, even though it won't do any work for us. But low-grade heat, such as exists at this very minute in Lake Ontario, is completely useless because of its low temperature, even though there are millions of B.T.U.'s of it there.

it into the house at a higher temperature. In the summertime we could set the device so that it operated in the opposite direction, removing heat from the circulating water of the house system and giving it back to the water of the lake, or in other words it would remove heat



It might rightly be said then, that a device which would take up this low grade heat of which an unlimited amount would cost us nothing, and raise its temperature to bring it up to even the medium-grade level would be of great value. For instance, if our home were situated near the lake, we could set up this device on the lakeshore and let the cold water run through it. When the device was operating, it would remove the low-grade heat from the cold water, grade it up to a temperature of about 135° F., and then transfer it to the water which circulates through the heating system of the house. In this way the device would be removing heat from the lake at a low temperature and putting

from the house and deliver it to the lake, and in the process the house would be cooled.

A machine that would perform these functions seems almost fantastic, and yet this last operation is performed every single day in nearly everybody's home. The device which does it is about five feet high, three feet wide and three feet through, is painted white and you are not supposed to put bananas in it. Our refrigerators do this very thing when they remove heat from an insulated box and deliver it to the air in the kitchen, cellar, or wherever the actual machinery is situated. The heat pump will be so designed that it will be able to perform both heating and cooling operations.

The actual operation of the heat pump is not difficult to understand if the thermodynamic ideas mentioned previously are remembered. Consider the schematic sketch of the principle parts.

The circuit consists of compressor, condenser and evaporator coils, (zig-zag lines), and throttling valve, arranged as shown. The whole system is completely closed and contains some refrigerant such as ammonia, Freon 12, etc. The compressor draws it refrigerant and compresses it into the condenser, where it liquefies, (changes to the next lower state). When this occurs the refrigerant gives up its latent heat of vaporization, and this heat is received by the water from the house heating system which is circulating around the outside of the condenser coils. The water therefore gets hotter, and flows on to give up its heat to the house through the radiators or panel heating system.

The liquid refrigerant then passes through the throttling valve into the low pressure part of the system. The lower pressure is maintained by the suction of the compressor, and the throttling valve acts as a sort of gate between the high and low pressure parts. In the vaporizer the pressure is not high enough to keep the refrigerant in the liquid state so it boils off. As this happens it changes to the next higher state, and in so doing it must receive its latent heat from somewhere. This latent heat arrives in the cold water which we get from the lake or elsewhere and circulates around the vaporizer coils. The refrigerant, now in the gaseous form, passes on to the compressor and begins the cycle anew.

The different operating temperatures are suggested on the sketch. The liquefying temperature of the refrigerant in the condenser should be about 135° F. for the heating system of the house to operate with any sort of effectiveness. The evaporating temperature in the vaporizer should not be lower than 32° F. in case the cold water is frozen solid and damage results.

This heating device may easily be converted to a cooling device by one of two means. Either the water circuits may be arranged so that the house circulating water is diverted into the vaporizer and the lake or source water is diverted into the condenser, thus cooling the water in the house system and warming the lake water or the refrigerant circuit itself may be arranged so that the direction of the refrigerant s reversed, that is, it is liquified in the vaporizer giving up heat to the lake water, and is boiled off in the condenser, taking heat from the water in the house system. The first-mentioned means is likely the better, but in either case it should be noticed that the heat pump is now operating as an ordinary refrigerating unit.

It has been previously stated that the heat pump when running on electric power wi l consume only a quarter of the electricity which would be required for the same amount of heating if the electricity were merely converted directly into heat by means of resistance heaters. This fact often requires profound explanation, but it may be seen in the following manner. Let us assume that the condenser and vaporizer temperatures are 135° and 32° as in the diagram. The thermal efficiency of the heat pump, as for other devices, is simply the ratio of the output to the input. The output of the heat pump is a certain number of heat units having a temperature of 135° F. The input to the heat pump is the heat equivalent of a certain number of units of electricity required to run

it—a certain number of heat units having a temperature of 32°. This output to input ratio will have some value less than one as we cannot expect the heat pump to operate perfectly. However, since we obtain all our low-grade heat from lake water or some other source which is obtainable in unlimited quantities at no cost, we usually neglect this quantity in the input term and simply consider the input to be the heat equivalent of the number of units of electricity required to operate the heat pump compressor. The ratio of the output to this new revised input is called the coefficient of performance. It is the value generally employed for heat pumps and refrigerators, and since we are neglecting a large quantity in the denominator of the fraction, the value of the coefficient of performance is nearly always greater than one. If we remove four units of heat at 135° from the heat pump for every one equivalent unit of electricity supplied to the heat pump compressor, then the coefficient of performance will be four, or in other words the heat pump uses only one quarter of the electricity which would be required for the same amount of heating if the electricity were converted directly into heat.

The degree of perfection of most thermodynamic operations which are performed in cycles is generally judged with respect to a similar operation performed on the Carnot cycle, for the effectiveness of any thermodynamic cycle of operations is always optimum when those operations constitute a Carnot cycle. A heat pump operating on the Carnot cycle and between the temperature limits of 135° and 32° would have a coefficient of performance of 5.77, but this cannot be achieved with any known refrigerant or refrigeration machinery, so that we are quite fortunate to attain 65% of this value or 3.75, which is nearer the value of four which has been previously cited.

It might well be said that very few of us live close enough to lakes to be able to use lake water as a source of heat. The rather interesting answer to this question is that although we may be six miles from lake water we may be less than 100 feet from ground water, and localities in which some form of water could not be obtained for this heating purpose by drilling wells are likely in the minority. The water obtained does not need to be pure drinking water, in fact, chloride salts dissolved in it would be beneficial as they would lower the freezing temperature. In addition, the temperature of ground water is higher than that of lake water in winter, and this adds to the effectiveness of the heat pump. The problem of a source of heat however, is an extremely important one, and is often the governing factor in the practicability of installing a heat pump.

The heat pump as a domestic heating unit is thermodynamically sound in every way, but it is obviously not sweeping the country and the reason is that it suffers economically in competition with other types of heating devices. Although a heat pump having a coefficient of performance of about four costs less to operate in Canada than an oil or gas furnace, and only slightly more than a coal furnace, nevertheless the first cost of the heat pump is more than double that of the gas or oil furnace.

We know however that heating with gas is expensive, that our stocks of liquid fuels are rapidly vanishing, and that coal strikes are nerve-wracking. With the heat pump we eliminate all this, and in addition we can use it for cooling as well as heating. Its very high first cost, however, means that for a few years at least the heat pump cannot be much more than a rich man's plaything.

The Rhyme of a Roving Skuleman

I created this fable in England, in a grey little Hampshire town,
We were sitting crouched 'round the fireplace, while outside the rain poured down;
A varied crew, with scarcely a clue as to who the others were,
We were spinning the tales, amid chuckles and wails, of young bloods without worry or care.

And then lifting his head, someone suddenly said: "Hey lad, why not give us the gen,
On this fabulous country, this Canada, where you say that men are men,
And women as lovely as angels are common as grapes on a vine!"
So I gulped down some tea and with rare fluency, I shot him the following line:—

"We're a happy bunch, in Toronto, they call us the engineers,
We're the modern day successors to the old-time pioneers,
I'll admit we don't carry six-shooters—we carry slide rules instead—
But we still hear the howl of a wolf on the prowl who has sighted a lady in red.

"One of our boys was ambling down Toronto's golden street,
He hadn't a cent in his pocket (though the gold-dust lay at his feet)
He passed a local dance hall, and heard the rhythmic din,
So he simply snarled, "I'm an engineer," . . . and of course they let him in!

He entered the gloom of that sordid room with his eyes two spots of flame,
And he wandered around like a hungry hound till he saw the best-looking dame,
He strode right up to her partner, and kicked him hard on the shin,
Then growled with a sneer: "I'm an engineer!" . . . so of course, she let him cut in.

He went to church some years later, for the first time in his life,
(To tell you the truth, he was dragged there by a conscientious wife),
When the ushers passed the plate around, they heard a drawn-out sigh:
"Dear friends, I fear I'm an engineer!" . . . so of course, they passed him by.

He took to a lot of card-playing, as the years went drifting past,
He decided it beat engineering for collecting finances fast,
Till one day, upon playing five aces, he condescendingly said:
"Excuse me, you blokes, just an engineer's hoax!" . . . so they pumped him full of lead.

He went floating blissfully upwards, to bid St. Peter good-day,
He checked flying time and rate of climb on his night-shirt all the way,
He was almost inside the pearly gates, when he gave a hearty shout:
"Hey Pete, have a beer with an engineer!" . . . so they hastily booted him out.

We have a good time in Toronto, we're red-blooded young engineers,
We're the modern-day successors to the old-time pioneers,
I'm not too free with philosophy, but this thing is worth knowing well,
If you want to be wild in the After-life, you've got to do it in hell.

E. FRAENKEL.

Prospecting-Bay Street Style

C. W. Daniels

BUY "GOLD BLOWN" Yellowpen. Don't wait, get to your broker now and buy a sure fire gold stock. This is a typical advertisement in our daily papers, possibly accompanied by a small sketch, which the average layman takes as a map to his dreams of buried treasure, and sinks his hard earned fortune into nothing but a promoters hollow promise.

Seeing is believing and it is the only way to know. Though not an experienced prospector by a long shot, I have spent a short while in the "field" and have seen what can go on.

Two summers ago my partner and I were placed on a small property in North Western Quebec and given brief instructions to prospect a certain area. We set up our camp on a suitable spot on the location, which we shall call property X for convenience, and the next day started out along the range line, which outlined the northern border of our property.

Well you need rock to get ore, so we started a compass and pace survey back and forth across the property in search of any sign of an outcrop. After about a week of tramping across the knee-deep muskeg we decided to take a day off and hike into town. It was a five mile walk but at least it was a good dry road. We reached town about noon and decided to buy a newspaper to see how the rest of the world was living. Glancing through the paper we chanced a look at the stock page and sure enough there it was.

X Company doing extensive exploration on new property right next door to Y property—already a large producer. The President of the X Company reported that stripping and trenching were in progress, and a diamond drill was going in shortly. (Incidentally Y property had been abandoned two months before.)

Well we just looked at each other and roared. It was our property alright, there was a map to prove it. How many people had swallowed this? Quite a few I suppose, for the market quotation on the "Under the counter Stocks" showed considerable movement in the stock.

You have often heard the Mining Business called the Mining Game. Well it is a game, when the Bay Street Brokers play it, only they are playing it with somebody else's money. There has been a lot of excitement in mining circles in the brief period following the war, but promoting false properties will not find Canada the ore bodies she so badly needs. Her present mines can't last forever, so come on you miners and geologists, make that all important find. Don't waste your time tramping around in some Moose Pasture.

The ever increasing use of improved magnetometers for the search of ore is revolutionizing the prospecting business, ground is being covered at an incredible rate. Canada must find more ore bodies and she will if you take this important task to heart.

College Boy

K. E. Hunter

I AM standing outside the Woodbine track one day and, having made a small investment in Dandy Boy at twenty to one, who wins very nicely, am feeling friendly. So when I see Gentle, I give him a big "Hello" although ordinarily he is not the kind of character I would give even a small "Hello." For I often hear rumors that he engages in activities that most citizens frown upon, such as opening safes.

In fact, I hear the coppers wish to see him about a matter of a night watchman who is mussed up no little, when he tries to stop Gentle from opening a safe. Indeed, the night watchman dies two days later. So Gentle is very hot; about as hot as Joe's curr'ed chicken, which is very hot indeed.

"Come with me to Joe's," says Gentle, "as I wish to consult with you about an mportant matter."

Now ordinarily, I do not care to be seen with hot characters, espec:ally with characters as hot as Gentle, but as he might misunderstand my refusal to go to Joe's with him and become angry, I go along with him as when Gentle gets angry, he is just as likely to put the blast on you as not.

Well, when we are sitting in Joe's waiting for our chili-con-carne, Gentle speaks to me as follows:

"I wish to retire from business for awhile," he states, "as I find it extremely hard to open safes with the coppers looking for me all the time. I cannot go to Montreal or Windsor or almost any place, for the coppers are looking for me there too. I wish to retire to a place where the coppers will not look for me at all."

That is the very difficult order indeed, I say, but let me think a while.

I do not really believe that I can think of any place but with a character like Gentle it is just as well to show some interest. I am half way through my chile when the idea comes to me.

Gentle, I say, why do you not go to College for awhile. College is just beginning now and I am sure the coppers will not look for you there.

"Why," says Gentle, "this is quite an idea indeed."

Now I do not think very much of it myself but I am glad to tell Gentle thinks so, so I do not say anything.

Well, I do not see Gentle around for quite some time until one day I am in the K.C.R. quenching my thirst when who do I see but Gentle with a bunch of college boys. I give him a large hello and he comes and sits down with me.

I do not see you around lately I state as I am very curious.

"That is a wonderful idea you have," he says, "I am at University College now taking a course called Sock and Fill. When I first go they ask me for a certificate of senior matriculation. Now, of course I have not got such a thing so I go to a high school principal I hear about and ask him to give me one. He is somewhat reluctant as I have never gone to school much but I show him my persuader and he gives in and I get entered into college.

"One day there is a football game between the Torontos and the McGills and

Continued on page 24

That New Building

H. E. Ansley

AT an unpublicised meeting of the Faculty Council last year a very heated argument arose over a current controversial question. Statistics were quoted, charts were shown, tempers were lost, and invective was thrown around—all because of this important problem. Fortunately however, calm, reason and logic finally prevailed. It was decided that, despite the large numbers of engineering students at present in attendance this enrollment must be considered abnormal, and accordingly only one SPS Cocktail Lounge is really necessary.

A convenient site was quickly chosen at the corner of College and St. George, and all Departments co-operated on the designs for the structure and fittings. Plans were drawn up by members of the School of Architecture. The ground floor will be devoted mainly to a single room containing one long bar. It is understood that a portion of this bar will be of less-than-usual height, and will be used for the express purpose of serving short beers. A novel feature is to be provided by the Metallurgists who are now hard at work on the design and fabrication of a modern, comfortable, "foot-fitting" brass rail. Space is being set aside upstairs for the Chemicals, who will, as soon as possible, set up several of the latest-type, super-special stills (capacity forty beers, the standard volume). The Mechanical and Electrical Departments are collaborating on the designs for elevators, conveyors, pumping machinery and other equipment so that supplies will be readily available in all parts of the building: "on tap at all times" is the specification outlined in the contract. Another interesting feature is that two extra-wide escalators direct to the roof will also be installed, These are for the many expected occasions when "the drinks are on the house."

Considerable study has also been given to the servicing and operation of the Lounge. Practically all the members of the Staff have asked to be appointed to serve behind the bar, and a Special Committee, under the usual Chairman, has been set up to attend to these applications. Several new recipes are at present being tested for degree of 'proof,' alcoholic content, Kick Factor, etc. One particular concoction, Aqua Hydraulica, is being especially recommended.

The Department of Engineering and Business, by unanimous consent, is to have control of the trading and fiscal policy, and to assist in this task the Department is currently preparing statistics of normal consumption, and above-normal or post-examination consumption.

As is noted above, many members of the Council who were judging from their wide experience in these matters had demanded that more than one Lounge be set up. The argument that finally won them over was the decision to widen the distribution of Skule Spirit by a daring innovation. When the new building has been completed a series of pipe lines will be installed between it and all existing buildings at the south end of the campus. At the time of writing a diesel excavator is busy digging the necessary ditches. These pipe lines are being put in for the benefit of the Staff, of course,

and it must be strictly understood that the students will have to spend at least two periods a day in the new building itself.

It is hoped that these few remarks will serve to answer many of the questions which have been troubling the minds of students since construction work was started, and that when the new edifice is opened it will be considered a truly worthy addition to the facilities of SPS.

College Boy . . .

(*Continued from page 22*)

the college boys all go to cheer for the Torontos. I am there but I do not see much to cheer for as I have personally placed a small sum upon the McGills, due to the fact that that Tommy the Half back tells me that the Torontos are most disgusted with their wages and are considering having a small sit down strike around the middle of the fifth quarter. It isn't till some time later that I learn from one of my professors that there are only four quarters in one game. However there are some little dolls in short dresses who are dancing down on the field and who are something to cheer for indeed. There is a lot of shoving and pushing and the Torontos shove harder for they win the game.'.

"After the game I am trying to get close to one of the dolls when a bunch of McGills come along and try to put the slug on me. Then a bunch of Torontos come and try to put the slug on the McGills. I have not got my Betsy with me as the college boys tell me it is not the custom to take Betsys to football games and I take a rap on the noggin."

"When I wake up I find my head in the lap of one of the dolls in short skirts and as it is very pleasant indeed I go right back to sleep. Her name is Miss Gerry O'Neill and she is a wonderful little doll, in fact she is so wonderful I am burning up with love immediately."

I listen to him talk about Miss Gerry O'Neill and he shows me a picture of her and I can see with half an eye that she is a nicely built doll indeed although nicely built dolls are a dime a dozen practically anywhere."

"Miss Gerry O'Neill," he says, "is also a very high minded doll and has very fine ideals. In fact she tells me that her old man has plenty of potatoes and that she is afraid her old man's potatoes may come between us."

"I assure her that I love her all the more for her old man's potatoes and she tells me I am very noble indeed."

When he says this I think that Miss O'Neill is just another dumb doll even if she does go to college. For I notice from time to time that a few dibs can make even a scraggy old doll very attractive.

"Well anyway," he says, "she is going to become my ever-loving wife as soon as I graduate."

"But how can you graduate?" I ask. "Do you not pass examinations to graduate?"

"Yes," Gentle says, "but I find out the examination papers are put in the Dean's safe the week before the examination."

"And the Dean's safe," he says, "I could open in the dark with a can opener."

The Export of Brains

G. F. C. Weedon

"How can we stop the export of youth from this Country?" This current and vital problem was the subject of a forum discussion by Gordon Sinclair, Jr., Ken Croft, Garth Weedon, and William Torgis at the Canadian Club Luncheon held at the Ball Room of the Royal York Hotel on Monday, February 17th, 1947.

This paper is the contribution to the Panel by Garth F. C. Weedon, B.A.Sc.—demonstrator in the Department of Electrical Engineering and of the School of Graduate Studies.

In the past ten years, 100,000 young men above average intelligence and initiative have left Canada for the United States never to return. This represents an investment of 300,000,000 dollars which Canada has lost through inefficient use of her educated young men and women. At this time of expansion in Canada, this subject is vital both to Canada's future and to the future of her University Graduates.

The following is the text of Mr. Weedon's talk:

BEFORE we can analyse the reasons why Canadian youth is now leaving our country, we must realize into what category the larger proportion of these emigrants fall. We are not concerned with what might be called the average youth, but with the more exceptional group who have the greatest potentialities for leadership in Canadian civil and economic affairs. These potentially great men are leaving Canada. We must naturally assume then, that they are dissatisfied with conditions as they exist here, and that they look for a better fulfilment of their ambitions elsewhere. If these men are to mould the Canada of this generation, they must find that for which they are seeking. And what are they seeking?

First, I would rate opportunity. Youth must have a chance to prove his worth to himself. The exceptional youth, aware of his capabilities must be given the opportunity of using them. He cannot, and will not be content, unless his future holds the assurance that his talents will be employed to their fullest extent. You can't expect youth to work to provide himself with better than average materials, and then ask him to expend these materials and prostitute his superior abilities on a mediocre job!—Granted, youth owes something to the land of his birth,—but he owes also much to himself, and his future. If we can but provide our exceptional youth with a real opportunity of working, and of attaining a moderate success in Canada, our youth will respond eagerly, and not only return tenfold the investment of Canada, but will carry Canadian society and economics to heights it could not otherwise reach.

The second important fact of this problem is recognition. Youth's ability to fill a responsible position in business at an early age, must be recognized. Now take the case of the young University graduate. We have a mind sharpened to a keen edge, and with a firm foundation of general knowledge. Used improperly, this individual's talents will be frustrated, and business never will receive the full benefit of his latent abilities. Would you buy a 1947 automobile and leave it in your garage for twenty years before you use it? Then,—why buy the executive abilities of this graduate and leave them unused for twenty years. The widely held concept that you must have grey hair and considerably rotundity before accepting major responsibilities is costing millions of dollars in wasted dormant assets. American business wants

Canadian youth, and deliberately creates attractive openings for them. Can we not attain comparable recognition here in our own country?

Our third great need in meeting this urgent situation is adequate remuneration. When we ask for adequate remuneration,—in effect, we ask for more money—but we do so at an increased service to you! Canadian Youth is not asking for a contribution from business, but, through greater opportunity and recognition is attempting to better its own position by a fuller contribution to business. Canadian youth is capable of giving more than they are giving, and particularly more than you are asking of them. We are not asking something for nothing.

So far, we have stated the reasons for this exodus of Canadian youth. Now we shall attempt to suggest a solution.

During the war years, great effort was exerted and sacrifice made abroad by youth to protect Canada's way of life. In the coming years, what can a similar effort accomplish here at home? Science has made Canada the crossroads of the world. Youth can make of Canada in her newly-found strategic position, a guiding light in the world of their generation. This great responsibility cannot be shouldered without extensive preparation. To know Canada, youth must understand and appreciate Canadian business and politics. They must know the physical, moral and spiritual problems of the Canadian people, in relation to one another, and in relation to the world as a whole. This can be partially accomplished by taking full advantage of both intra-mural and extra-mural educational opportunities already available. If youth can be made to realize the great potentialities of this country, then the migration southward will be arrested.

Secondly, what can Canadian businessmen do? Possibly the greatest effort to retain Canadian youth must be exerted by businessmen. Canadian business must compete with foreign labour markets by providing to her youthful employees, equal or greater opportunities than can be found elsewhere. Business can forstall this exodus by an early interest in youth, and by making these opportunities known as they become available. Business in conjunction with education must make a determined effort to fit youth into its most advantageous position instead of following the mutually disadvantageous policy of grinding him down till he fits.

Business must remove the monotonous atmosphere in work. The attitude which this produces has a serious psychologically destructive influence on youth during his years of ambition. If not the only outcome can be a group of men whom, when called into the executive ranks are resigned to a passive attitude. We are prepared to start at the bottom of the ladder, but won't you pleaase give us a chance to climb quickly! Canadian business must lose its inferiority complex, rid itself of the technical and scientific dictatorship of outside business, and strive to lead the field with pride in its own line of endeavour. Business must make youth feel its importance, by showing the reason for working and the contribution which he is making. You must give youth wise guidance, a sympathetic interest, and an opportunity here in Canada —for you are the ones who will profit.

What can we as Canadians do? *(Continued on page 36)*

The Kingdom of

The Saguenay

C. H. Busby

Introduction

WHEN Jacques Cartier sailed up the St. Lawrence, he was so impressed by the grandeur and sheer beauty of its second tributary that he called the area dominated by this mighty river "The Kingdom of the Saguenay". The Saguenay was first utilized as a highway for trappers, fortune-hunters, and settlers. Within recent times, it has been developed commercially as a source of electric power. During the war when the Shipshaw project on the Saguenay River was completed, the total maximum generating capacity of the river was increased to 2,000,000 horsepower. This system is at present considered one of the largest, and probably the most concentrated hydro-electric network in North America.

History and Development

IN the annals of Canadian engineering, the hydro-electric development of the Saguenay River is considered to be one of the foremost achievements.

The first feature of the Saguenay power development is its natural setting. Some 30,000 square miles of territory, mostly virgin forest, drain into Lake St. John which covers an area of four hundred square miles. From Lake St. John, the river rushes thirty miles over rough terrain dropping 320 feet to tidewater at Shipshaw.

The possibilities of developing hydro-electric power in this area were first realized as early as 1898. Surveying of Lake St. John district and accurate measurements of daily discharge into the Saguenay from the lake were recorded. Three pioneers of the district obtained power rights for the complete drop in the river but due to the huge financial undertaking, no project was started. In 1913, Mr. J. B. Duke, a financier from North Carolina, visited the Saguenay area and was so impressed by the rapids at the Shipshaw site that he purchased the entire power rights of the river. Mr. Duke and his associates realized the necessity of regulating the flow from Lake St. John, and a site about six miles from Lake St. John called the Grand Discharge was proposed as the location for the first power development on the Saguenay.

It was necessary to find a market for the anticipated power. Mr. Duke originally planned on using a large percentage in his nitrogen fixation process, but the idea was abandoned as unfeasible. An agreement however, was made with Sir William Price to use some of the power in the pulp and paper industry which was expanding rapidly in the district.

The power project at the Grand Discharge was started in 1922. It was known as the Isle Maligne power development. This power house was completed in 1926 and plans were ready for further development of the Saguenay at the Shipshaw location before the Isle Maligne project was finished. In 1925, the Aluminum Company of America laid plans for the construction of a large

factory for the manufacture of aluminum near Chicoutimi, Que. Late in 1925 Mr. Duke and Mr. A. V. Davis of Aluminum Company came to an agreement on power rights. The decision of the Aluminum Company to build at the Saguenay river site meant a ready market for all the power developed.

Preliminary construction of the Shipshaw project was begun in 1926, but little progress was made. In 1928, a revision of plans laid down earlier was completed in order to provide some power in less time. Two power houses were to be built instead of the one originally planned. A concrete dam across the Saguenay River, just above Chute-a-Caron was fitted with eleven Stoney type sluice gates and a free spillway that could discharge up to 600,000 cu. ft. per second. The No. 1 powerhouse was located in the main dam across the river. The advantage of this development was that the second Shipshaw project could proceed while the first installation was producing power. In Shipshaw No. 1 (Chute-a-Caron), four 50,000 Kva generating units were installed. This was completed and preliminary work on Shipshaw No. 2 was begun. The depression in 1930 forestalled further construction because the demand for aluminum dropped, thus the power demand by the Aluminum Company dwindled. Construction discontinued from 1931 to 1938, the units at Chute-a-Caron were used to make power for steam generators and half of the water in the river ran idly over the dam the year around.

In 1937, the demand for aluminum began to increase. The Aluminum plant planned for expansion, thus a large portion of the power would be used by the Arvida Plant. When war was declared the British Ministry of Supply wanted more aluminum quickly, thus new engineering studies began in earnest. The old Shipshaw plans were again reviewed. It was decided that two generators could be installed at Chute-a-Caron as a temporary measure while the orginal Shipshaw plan could be further studied and modified. Then finally on May 15th, 1941, the No. 2 development was granted to the general contractor to commence. The story of the final construction of Shipshaw is part of the story of Canada's war effort. Time schedules impossible though they seemed were met, and on November 20th, 1942, construction culminated with the opening of the tailrace to the river by an 83,000 lb. shot of dynamite. Five days after the water entered the tailrace, two of the 75,000 Kva units were in operation. With the installation of the other ten units, the total maximum production of power by the Saguenay System was increased to 2,000,000 horsepower.

Technical Aspects

THE Saguenay System, a 60 cycle system based on the Isle Maligne and Shipshaw hydro-electric developments has been built to a capacity of 2,000,000 horsepower. The Isle Maligne plant has an installed capacity of 540,000 h.p., Shipshaw No. 1 has 300,000 h.p., while Shipshaw No. 2 has a capacity of 1,200,000 h.p.

The natural flow of water from Lake St. John varies from 300,000 cu. ft. to as low as 8,000 cu. ft. per second in the winter time. It was found necessary to regulate the flow of the Saguenay before such a large power project as Shipshaw No. 2 could operate efficiently the whole year round. It was found later that the Saguenay System could operate for five months on storage with a possible maximum of nine months. Lake St. John functions as a storage reservoir

but was found inadequate over periods of the year. During the war years, two storage dams were constructed. The Grand Peribonca, a major tributary of Lake St. John was brought under control by the construction of Lake Manouan and Passe Dangereuse water storage developments. The storage provided by Lake Manouan being 78.5 billion cu. ft. and that of Passe Dangereuse being 183 billion cu. ft. In the construction of these dams, all materials were transported by air to Manouan but a road of more than fifty miles in length was built to Passe Dangereuse. The total effect of the unstored run-off and the storage on the Saguenay now ensures an average maximum regulated flow of 42,500 cu. ft. per second at the two power developments.

The water head of the Saguenay was developed in two successive stages. The first stage of the head was at Isle Maligne. Owned and operated by the Saguenay Power Company, Limited, it contains 12 vertical Francis water wheels each rated at 45,000 horsepower, 112.5 r.p.m. 110 foot head, with direct connected 35,000 Kva, 13.2 Kv generator. The generators are ventilated by an open system, cool air being taken over the tailrace through the wheel pits and generators to the generator room whence it is discharged to the atmosphere through the generator room window and roof ventilators.

The site chosen for the second head concentration was immediately above the Chute-a-Caron rapids where a dam was constructed. The dam controlled a normal regulated head of 155 feet. A power house was located in this dam. It contained four vertical Francis water wheel units developing about 75,000 horsepower each under 155 ft. head with 50,000 Kva, 13.2 Kv, 120 r.p.m. generators. These generators have an open ventilating system, with cooling air being taken in from above the tailrace. The discharge from the Isle Maligne Plant was 50% in excess of the requirements of the Chute-a-Caron power development. The generators in this plant were overloaded considerably before the construction of Shipshaw No. 2 due to the large wartime increase in demand for aluminum.

The largest and most recent power development on the Saguenay is the Shipshaw development which had been planned as early as 1925. This project was known as Shipshaw No. 2. The Shipshaw No. 2 generating station takes water from the same forebay as Shipshaw No. 1. Each of six 30 foot diameter shafts and tunnels supply two single runner vertical Francis turbines. Eight of the units are rated at 100,000 horsepower while the remaining four are listed at 85,000 horsepower, making it at the present time the largest single power station in the world. Ten turbines are directly connected to three phase generators having a capacity of 75,000 Kva each at 80% power factor. The two which were originally installed at Chute-a-Caron retained their 65,000 Kva rating when relocated. The performance of the installed turbines was of utmost importance. The field tests of the units were gratifying. The Gibson test of the turbines compared most favorably with all other hydro-electric installations in North America. The number nine turbine unit at Shipshaw was tested and the results showed it to be the most efficient turbine in North America with a rated efficiency of 95.4% under a head of 208 feet.

At Shipshaw No. 2, a closed ventilating system for each generator was decided on, partly because of experience with

open ventilating systems at Isle Maligne and Chute-a-Caron and partly because of the low temperature of the cooling medium, water from the forebay, thus permitting maximum utilization of the generator capacity at all times. The air from the generator rotor and stator is circulated through water-cooled heat exchangers whence it is discharged to the turbine pit and through the rotor to the stator.

The Saguenay System depends on storage water for winter operation or during dry periods in the area. It is essential that the greatest efficiency be obtained from the available water particularly during the period when the system is operating on storage. To facilitate this, a turbine gate opening indicator was devised. This consists of a selysn transmitter mechanically actuated by a rack on the turbine servomotor cross head. The receiving indicator for each unit is mounted in the control room where the operator may keep constant check on position. The point of best gate for each unit is marked on the dial of the indicator for that unit and any deviation may be instantly detected.

The electrical installation of Shipshaw No. 2 was somewhat simplified due to the short distance of transmi-sion to Arvida and the uniformity of the Arvida load units. Shipshaw No. 2 was laid out on a unit basis with no low tension bus or low tension circuit breakers.

The generators at Shipshaw were supplied by two manufacturers. The electrical characteristics of the ten new generators are as follows: 75,000 Kva, 13,200 Kv, 80 percent factor, 3 phase with eight parallel circuits per phase, 60 cycle, 56 pole, 128.6 r.p.m. with a 60 degree Centigrade full load temperature rise. Each generator is equipped with a main exciter and a 250 volt pilot exciter and is designed to operate without main field rheostats but with a motor-operated exciter field rheostat.

The mechanical structure of the two manufacturers differs quite extensively. One manufacturer used the spider type upper bracket and a semi depressed oil pot. The rotor was of standard design with a cast spider The other manufacturer used fabrication to a great extent. A totally fabricated rotor was used w th sections built by welding plates and a bridge type girder upper bracket with a fully depressed oil pot. In this machine, both upper and lower end turns were readily accessible. Another feature of this machine is that the field coils and poles are arranged so that they can be readily disconnected at the top. The pole keys are pulled out by the crane and the rotor poles lifted out by the same means. Thus, damaged coil or coils may be removed without removing the rotor of the machine which is a saving of tim in servicing and also reduces the outage time.

The power transformers at Shipshaw are rated at 30,00 Kva, 13.2 Kv to 154 Kv. The transformers were supplied by two manufacturers with the condition that a transformer of one manufacturer would operate satisfactorily with the transformer of the other design. These single phase transformers are wye-connected on the high tension side, thus the total capacity of the transformer bank for each generator is 90,000 Kva. These transformers are protected not only by the standard differential relay protection but also have gas detector relays. This type of protection has proven a very efficient type of warning. It functions on the principle that any heating or arcing taking place in the transformer tank will tend to "crack" the insulation

oil, producing hydro-carbons of a higher order which rise to the top of the oil level. When sufficient quantities of gas have risen a float switch operates a relay giving a warning in the control room that the transformer is faulty.

Twelve high tension oil circuit breaker units are installed at Shipshaw. These breakers are standard three tank oil filled outdoor type, 161 Kv, 600 amps., 2,500,000 Kva rupturing capacity, having an interrupting current of 20,000 r.m.s. total amperes. The operating time is contact part 3.5 cycles, are extinguished in 8.0 cycles, contact fully opened in 25 cycles (based on 60 cycles per second). Heaters are provided to keep the oil at the required temperature during the winter months. These breakers are connected to the outgoing transmission lines through vertically mounted 600 amp., 161 Kv triple pole, motor-operated gang connected disconnect switches.

The transmission line connecting Shipshaw No. 2 generating station and the main substation consists of a 154 Kv double circuit. Shipshaw operates on the unit system, that is, one generator, one transformer bank and one transmission line to Arvida. The transmission distance from the Shipshaw No. 2 power house to the Arvida substation is approximately two miles. The amount of power transmitted to the bus at the Aluminum Company of Canada plant is in the order of 750 megawatts. The cost of the voltage transmission systems was approximately the same. The transmission lines have a span of 1,600 feet across the Saguenay River. The low tension lines would be of heavier construction, a saving of material would be possible if the 154 Kv system was chosen. Since Shipshaw was constructed during wartime, the saving of strategic materials such as steel, copper and aluminum justified the choice of the high tension transmission system.

Economic Aspects

THE Saguenay System has been developed in accordance with the increasing demand for electrical power by industry in the Saguenay region. Transmission systems have not been designed as yet that would make the venture profitable thus industry was brought to the Saguenay area. The load on the system is essentially industrial, therefore the power demand varies with the production of material by these industries. The two major industries in the Saguenay District are pulp and paper and the reduction of aluminum. These are exported in significant quantities, so the success of this hydro-electric development does not depend on local so much as world conditions.

The aluminum industry centred at Arvida and Isle Maligne is the user of greatest percentage of the available power. Recently contracts for aluminum were signed with England thus ensuring a large aluminum export of ingots for several years in the future. These contracts are of sufficient magnitude that production will increase to about two thirds of the wartime level in this district.

The pulp and paper industry has a relatively small demand for power as compared to the aluminum industry but since the termination of the war the demand increased. Many electric boilers are being installed in the various pulp and paper mills because of the cheap secondary power available. Considerable secondary power is sold to the Saguenay Transmission Co. Ltd. for distribution in the Quebec City area. The Saguenay Valley remains an ideal location for any industry which requires large blocks of power at low rates.

Asphalt Plants

R. J. Smith

THE use of asphalt surfacing in modern highway practice has developed rapidly. Many new highways are surfaced entirely with asphalt pavement. A notable example of this in the province was the paving of Highway No. 12 between Beaverton and Brechin. The mix for this paving job was obtained from a continuous-mix plant located at Beaverton and owned by the A. E. Jupp Construction Company of Toronto.

The fundamental principle of this plant is the use of independent portable units to perform separate functions at low cost. The development of these units has met with the engineers' demands for accurate control and the contractors' demands for reasonable maintenance costs.

These units can be operated in various combinations depending on the type of bituminous-road construction requred. The plant described here was set up as a central plant.

In the central plant set up, the aggregates are fed into a charging hopper by a crane. Beneath the hopper is a reciprocating feeder. The damp aggregates are placed on a cold elevator by this reciprocating feeder and are transported to the single drum drier.

A portable drier is used in the central plant continuous-mix operation. The high capacity of the drier is due to special cup-shaped lifting flights on the inside periphery of the drums. These elevate the aggregates and drop them in the form of a thin veil over the cross-sectional areas of the drum. The rate of movement of the aggregates through the drum is governed by gravity.

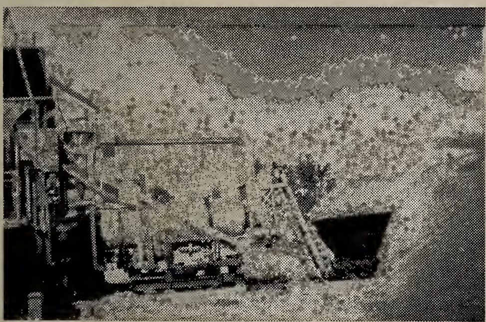
Fuel oil and steam are pumped into the drier under pressure and ignited. The resulting hot flame produces gases in the chamber and raises the temperature to 200°-350° F. As the gases pass through the veil of aggregates all moisture is removed and the materials pass on to a second elevator.

The drum which measures three feet in diameter, is mounted on a slope of six degrees. Its capacity varies depending on the type of aggregates and the drying requirements. Overheating is prevented by an automatically-operated fuel pump which stops when the drum stops rotating.

A dust collector is used with the drier. This is power driven by a separate unit. Material from the drier is discharged into a hot elevator which conveys it to a vibrating screen. The screen which is entirely enclosed, is supported on a steel frame over a three-compartment steel bin. This makes possible the separation into three sizes of aggregates. The apron feeder which forms the bin floor conveys the aggregation through a calibrated gate which may be controlled to feed various amounts from any bin. The quantity of material discharged from the feeder is directly proportional to the revolutions of the drive shaft for any setting of the calibrated gate. Tests have demonstrated a very accurate control of the aggregate flow through the gates. The drive shaft which operates

the gates is interlocked with the metering which supplies the bitumen to the spray Chamber.

When the aggregates passing through the gradation control unit have been properly recombined, they are elevated into the hopper of the mixer. They are conveyed into the spray chamber by an apron feeder, which forms the bottom of the hopper. In being discharged from the apron feeder, the aggregate falls through the spray chamber and into the pug mill.



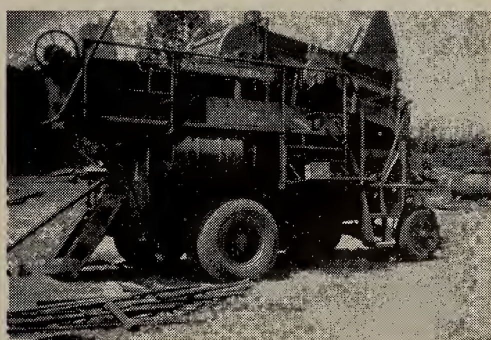
General view of the plant showing dryer, hot elevators and aggregate toppers

The pug mill thoroughly mixes the bitumen and the aggregate. The degree of mixing depends upon the length of time each particle remains in the pug mill and the amount of pressure exerted on it during that period. Interlocking paddles stir the mix to the proper degree. The output of the plant is then controlled by the time required to mix the bitumen and aggregate.

The bitumen tank is located in the lower part of the machine. The bitumen is heated before it is sprayed into the aggregates. Steam heating is usually used in this operation.

Three separate power units are used to operate the plant. One unit drives the feeder, cold elevator drier and hot elevator. Another unit drives the gradation unit. Power for the pug mill and the apron feeders is upplied by a third unit. Several smaller units of the plant are interlocked with the larger units and depend on them for their power.

The plant is very mobile. It can be dismantled, transported, and rebuilt in a matter of days depending on the distance transported. For short hauls the whole operation can be carried out in three or four days. The plant is broken up into four or five sections and shipped to its next location. Some of the units are moved on floats and other form trailer units.



The mixing unit is shown as it is moved from job to job

Toike Oike's had many an ed,
Who has wished that he were dead,
For the end of a page,
Leaves him in a rage,
When there s nothing there to be read.

A Short History on the
Evolution of Electricity

K. E. Hunter

FOLLOWING is a verbatim account of the first of a series of lectures given to first year students in the subject of electricity by the eminent scientist, B. A. Burdbrain B.S.

Gentlemen, before I begin my little lecture allow me to introduce myself. I am A. Burdbain—B.A. Burdrain that is. I wish to give thanks publicly to my wife Ima, who has been of great assistance to me in the preparation of these lectures. My wife is very dear to me gentlemen, when I die, the words Ima Burdbrain will be found graven upon my heart.

When I first came to this University I wished to learn the names of the young men whom I was going to instruct in the mysteries of science. I was talking to a young lady when I noticed a fine young man walking by, wearing a School sweater. I turned to her and asked, "Who is that young man?"

"That fellow," she replied, "he's A. Wolf." So I noted his name down in the little book which I reserve for that purpose. From what I have observed, the Wolf family must be widespread here at S.P.S. At least a large number of that family are in first year. A most remarkable circumstance, most remarkable.

Well, gentlemen, let us get down to the really serious business of electricity.

Electricity was first discovered by the Greeks but its source remained unknown until quite recently, when Benjamin Franklin made his brilliant discovery, in 1492 I think it was, or 1066. Benjamin, as a young lad, used to delight in watching thunderstorms, and he noticed that lightning always came from clouds. Knowing that clouds were made of water, he came to the conclusion that electricity was found in water. This was proven to be the case.

For many years some method was sought for extracting the electricity from water, but in vain. Then after the invention of the cream separator, a young scientist, Ampere I think his name was, thought of using the same principle to extract electricity from water. He whirled water around at a high speed and it turned out exactly as he expected. The heavier water was carried to the outside by the centrifugal force leaving the light electricity in the centre.

This principle is of course used in the modern turbine where large quantities of water are whirled about at a high speed, the light electricity collected at the centre being carried by the hollow shaft to the generator.

In the generator it is further refined into three components known as phases—the red, the white, and the blue. This refined electricity is led to large storage tanks where it is stored for distribution to the customers. A number of these tanks is called a bank, like a blood bank for plasma.

From the tanks the electricity travels by bus to the conductors. Just as in the T.T.C. there are good conductors and bad conductors—the bad ones being by far the most common.

(Continued on page 36)

Lament for a Lost Cause

Just the other week some student veterans got together and issued a statement which said that Canadian women were vastly inferior to European women because they were shallow, unapproachable, uncompanionable and conceited,

And immediately several coeds arose to the defence of their sex in a manner which, to say the least, was heated.

Goodness, they said, those men should try wearing high heels and skirts on the campus for a day, and maybe they wouldn't switch to sneakers and slacks in a hurry.

True, we may not go around reeking of Chanel No. 5, but we are as glamorous as the next woman when we dress up, and the lack of dates is the last thing about which we worry.

Now the newspaper that printed the article also ran a picture of the girls, and although it was impossible to tell exactly what they reeked of from such a coarse-grained photo.

Nevertheless it was fairly obvious that they were well-formed, attractive young girls and not Boris Karloff or Mr. Moto,

And though some of them, to be sure, may have been cheating by wearing girdles, Still they were a fairly presentable lot, and there seemed to be no good reason for anyone to take them over the hurdles.

Turning, however, from this fruitful topic to the veterans' distasteful utterance, I should like to point out that it was something more than idle, disconnected grumblings and mutterance,

For these gentlemen, while overseas, quite probably suffered more than the average fellow,

So much so that when they met a pretty girl they sometimes had barely enough strength left to say hellow,

As a direct result of which they either spent their spare time in the pubs with a profound thirst that required quenching,

Or else they went off to the nearest town, where, in the manner of the late Sir John Falstaff, they engaged in roistering and wenching.

Of course, such behaviour is very bad for the country, and can lead only to broken hearts, lost purposes and stomach ulcers in the long run,

But at the time it has the undeniable advantage of being barrels of fun;

Toronto, on the other hand, though it has many admirable features such as a beautiful skyline from ten miles out in the lake,

Seems, shall I say, inadequate for the purposes of the average unrepentant rake,

So that the ladies should regard the offending pronouncement as a blast against the society they were raised in

Rather than a searing fire they were being braised in,

And it does occur to me that they have really nothing to fear anyway, and can stop bleating like a goat of her kid bereft,

Because on sixty a month respectability can't help but be on the increase, and there's only a few of us left.

NORMAN FORBES

Evolution of Electricity . . .

(*Continued from page 34*)

The red phase electricity is used for heating in the stoves where its red colour is familiar to you all. The white phase is used for lighting, and the blue is used commercially for motors. The out of phase components, varying in colour from a pinkish green to a very dirty yellow, along with the reactive and inactive components, are discarded.

Now gentlemen, let us turn our thoughts to the units, one of the most important of which is the volt. In order to explain its meaning to you, I will give you the history of how it was discovered.

An Italian scientist was experimenting one day with a dead frog and a bowl of water containing some acid and two leads. He applied the leads to the frog's legs and was surprised to see it kick. In amazement he exclaimed "Volta!" which, when translated from the Italian, means "He kicks!" So ever after the amount of kick in electricity has been known as the volt. One volt is defined as the amount of electricity required to make a dead bull frog kick once. We all know that if we touch a line carrying a small voltage the kick is very slight, and if we touch a line carrying a large voltage we get a hell of a kick.

Forgive my language, gentlemen, but I get so interested in this subject that sometimes it carries me quite away. I have noticed that you are deeply interested in a number of subjects for you seem to be carried away quite often.

However, that is beside the point. You may make a note of still another source of electricity, that is in frog's legs—at least in small amounts although that is not as yet a commercial source.

But I see that my time is up and so I will close my lecture at this point.

The Export of Brains . . .

(*Continued from page 25*)

Probably the most important contribution which we as Canadians can make in keeping youth here, is that of promoting Canadianism. It is a long term remedy and cannot be fully accomplished without the help of everyone of us! We must in a sense glamorize Canada to enable youth to fairly compare the many advantages offered her at home with those elsewhere.

In concluding, I should like to present this thought provoking argument. Hitler taught us one thing. The power of Youth; the importance of ideas which youth absorb. If we create here a dissatisfied youth, we may create at the same time, a youth movement, which might, by either individual or group effort, attempt to overthrow the present system. If you value the present governmental and economic system, you will think seriously of the possible outcome of frustration and offence to our youth. The present system must, either prove itself equal to the situation or be replaced.

Gentlemen—Our Youth must find here in Canada, that for which they seek: . . . The Three Cardinal Needs . . . Opportunity, Recognition, and Adequate Remuneration.